MULTIVIBRATOR-TYPE VERTICAL-DEFLECTION CIRCUIT FOR TELEVISION

by J. S. MacDougall

INTRODUCTION

Multivibrator-type vertical-sweep circuits must keep the parts count down and yet must give good picture interlace with adequate protection for the output transistor. The circuit described in this bulletin employs four transistors in a unique multivibrator circuit in which the multivibrator is essentially separated from the influences of the horizontal information in the yoke. As an added protection for the output transistor, small nonelectrolytic capacitors are used for the sweep timing circuitry, and base clamping during the flyback is employed. With some slight changes in components, the circuit can be used with supply voltages from 12 to 26.

THE BASIC MULTIVIBRATOR

Fig. 1 shows the basic multivibrator used as the timing element for the sweep circuit. This is a variation on the complementary multivibrator and is so arranged that the transistor Q_2 has a grounded emitter to allow its use as a base clamp for the output transistor, as will be shown later. Although the timing in this simple circuit is determined by C_1 and its associated resistive components, in the more complex final circuit C_1 does not determine any of the timing but simply ensures that flip-flop latch-up cannot occur.

ADDING THE SWEEP

A sweep circuit can be added to the basic multivibrator of Fig. 1, as shown in Fig. 2. Here, the addition of transistor Q_3 makes no difference to the operation of the multivibrator during the "on" period since it simply acts as a saturated grounded emitter stage in the collector of Q_2. During the "sweep" period, however, the capacitor C_2 charges through the resistor R_7 and via the current gain of

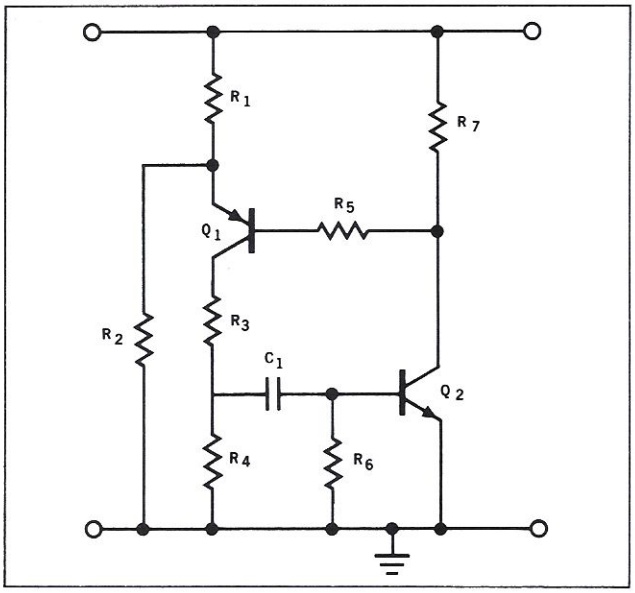

Fig. 1. Basic multivibrator.

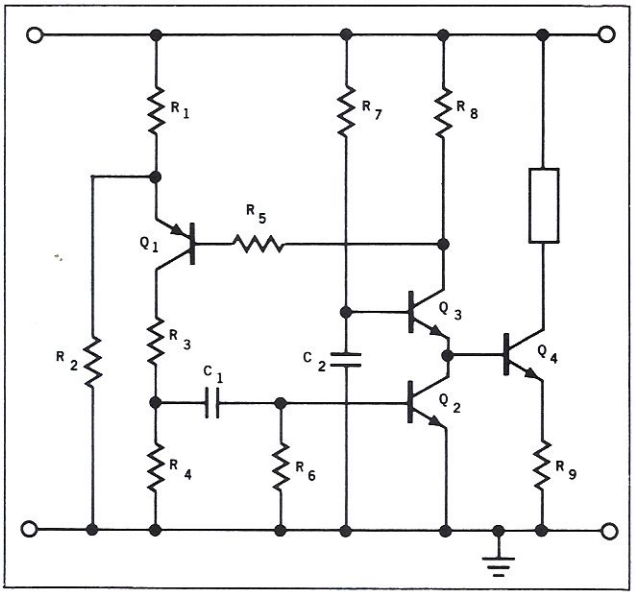

Fig. 2. Sweeping circuit with multivibrator.

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Q_3, providing a sweeping current to the power output transistor Q_4. The end of sweep is now determined by the point where the falling voltage at the junction of R_5 and R_8 becomes sufficiently low to turn Q_1 on and initiate the flyback cycle. In the simple circuit of Fig. 2, the sweep period is determined by the sweep-generating components, and flyback time is determined by C_1 and its resistors. Since it is important that the base of Q_4 be clamped off for the output inductive flyback, it is necessary to control the clamping action of Q_2 during this period. This will be described when the final circuit is presented; however, it is first necessary to show the output ringing circuit used to control the height and shape of the flyback pulse.

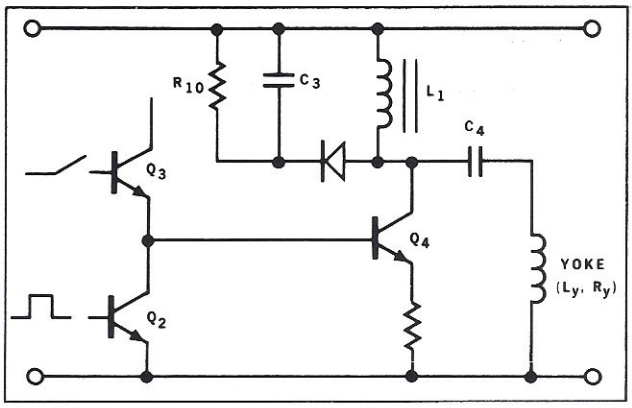

Fig. 3. Flyback circuit with base clamping.

THE OUTPUT RINGING CIRCUIT

Fig. 3 shows the output portion of the circuit with a diode and capacitor (C_3) added to control the shape of the flyback pulse. At the end of sweep, current is flowing from both the yoke and coupling choke into the transistor. When the base of Q_4 is clamped to ground and capacitor C_3 is omitted, the voltage at the output will rise according to L di/dt and will be limited only by the stray capacities and the breakdown voltages of the components. To control this wild output swing, capacitor C_3 is added to form a controlled resonance with the yoke and choke inductances. C_3 is not coupled into the circuit, however, until the output swing reaches the supply voltage and is only included in the circuit until the summated output current from the two inductances is zero. When the sum output current starts to reverse, C_3 is cut out and there is a very rapid drop in output voltage to slightly above the supply, whereupon the circuit is ready for the start of the next sweep. It is obvious that the current flowing through C_3 is an exact measure of the flyback time and, when properly sensed, can be used to control the clamping action of Q_2 to control the flyback action of the circuit.

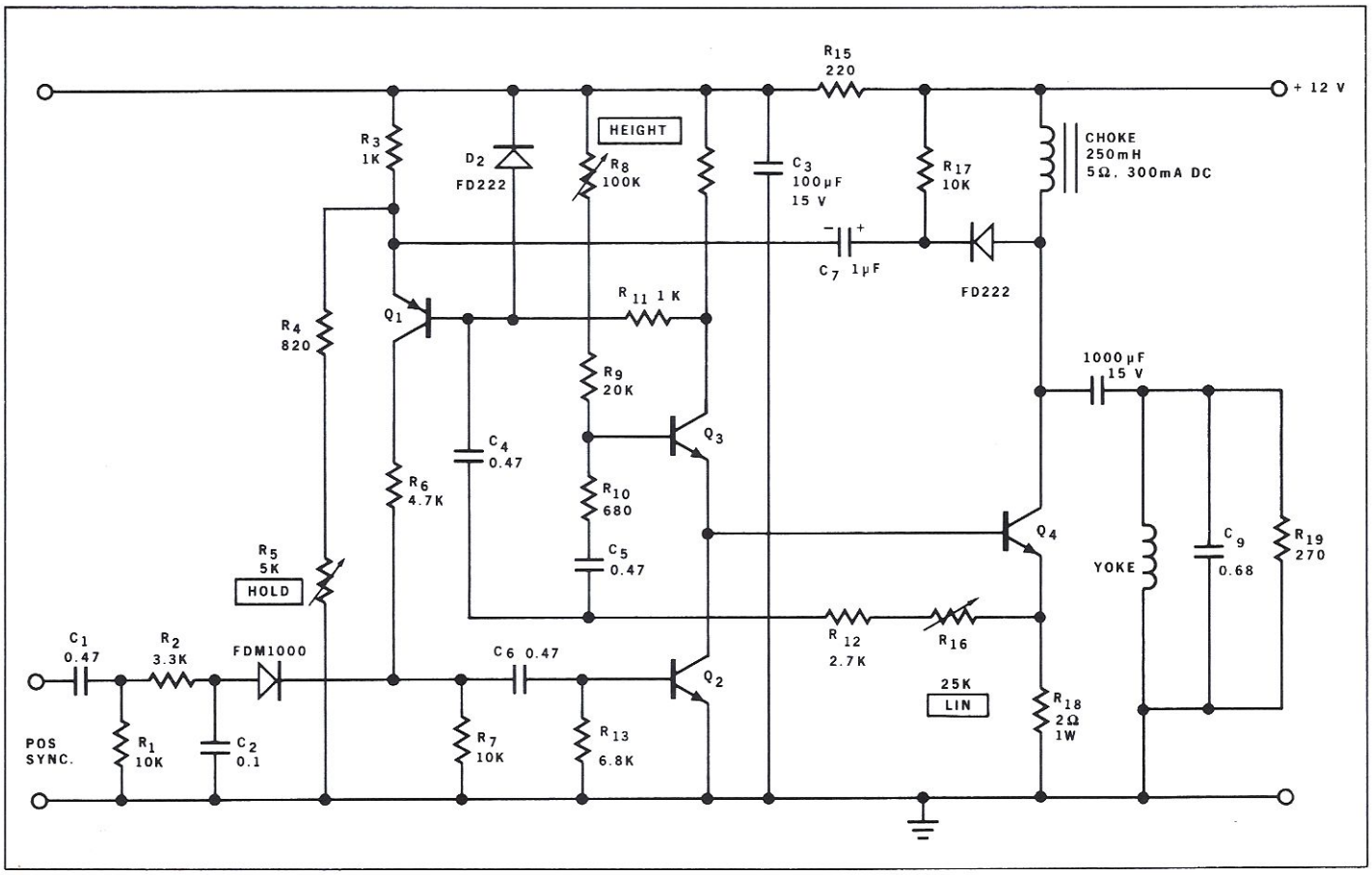

Fig. 4. Complete vertical deflection circuit.

THE COMPLETE CIRCUIT

Fig. 4 shows the complete sweep circuit containing the above-mentioned features. The output ringing circuit capacitor is C_7 and its current is sensed by feeding Q_1 through its emitter into diode D_2. The sweep timing capacitor has been split into two parts, C_4 and C_5, so that an integrated sweep signal can be added from the emitter of the output transistor via R_{12} and R_{16} for linearity control. C_4 is returned to the collector of Q_3 rather than to the ground to form a Miller integrator, thus eliminating some of the variability of Q_3. Resistor R_{10} is used to give a small step at the beginning of sweep to compensate for the V_{BE} drop of Q_4. During flyback the timing capacitors are discharged through the base emitter diode of Q_3. The circuit is synchronized by applying the synchronization pulse information with an amplitude of approximately 10 volts to C_1, while the necessary integration for sync separation is provided by R_2 and C_2.

PERFORMANCE

The circuit shown has been used to sweep a 12-inch 114-degree television tube having a final anode voltage of 12 kilovolts and requiring a 550-mA peak-to-peak vertical yoke current. With a slight variation, the circuit will also sweep a 19-inch 20-kV 144-degree television tube when operated from a 36-volt supply. The 12-volt version has shown good performance over the voltage range from 8 to 15 volts at temperatures of up to 70 degrees. As might be expected, there is some change in height with supply voltage variations, but synchronization is excellent under all conditions.

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